We claim:

1. A comprehensive input/output interface circuit for interfacing a process or machine controller with a sensor monitoring a condition within said process or machine or an actuator acting to modify said process or machine with a controller receiving inputs from said sensor or sending commands to said actuator; said interface comprising:

first and second electrical terminals for coupling with said sensor or said actuator;

a plurality of operation mode circuits providing different signal type input and output functions including a digital input function, a digital output function, an analog input function, and an analog output function; and

means for the controlling activation and deactivation of different ones of said operation mode circuits to provide a selected ones of said signal type input and output functions.

2. The interface in claim 1, wherein said means for controlling activation and deactivation including a microcontroller.

3. The interface in claim 2, wherein said microcontroller is adapted to receive control signals from an external controller.

4. The interface in claim 1, wherein said interface couples with said sensor or said actuator exclusively through only said first and second electrical terminals.

5. The interface in claim 1, wherein said means for controlling activation and deactivation including a microcontroller; said microcontroller is adapted to receive control signals from an external controller; and said interface couples with said sensor or said actuator exclusively through only said first and second electrical terminals.

6. An electrical input and output (I/O) interface comprising:

a first port for coupling said interface to a first external device;

a second port for coupling said interface with a second device;

an operating circuit communicating with a first signal set at said first port and communicating a second signal set at said second port and performing an operation on one of said first signal set and said second signal set as an input and generating the other one of said first signal set and said second signal set as an output; and

an operation selector selecting said operation performed by said operating circuit from among a plurality of operations.

7. The interface in claim 6, wherein said interface is a comprehensive universal configurable interface for interfacing a multiplicity of analog, digital, voltage, and current based signals over a multiple orders of magnitude signal range between a controller and a transducer.

8. The interface in claim 6, wherein said first port including first and second electrical terminals.

9. The interface in claim 6, wherein said first external device comprises a sensor.

10. The interface in claim 6, wherein said first external device comprises an actuator.

11. The interface in claim 6, wherein said first external device comprises either a sensor or an actuator of a machine or process.

12. The interface in claim 6, wherein said first external device comprises either a sensor or an actuator of a machine or process and said sensor or actuator are used to monitor or control said machine or process.

13. The interface in claim 6, wherein said first external device comprises a sensor or an actuator of a machine or process.

14. The interface in claim 6, wherein said first external device comprises a sensor generating a voltage signal.

15. The interface in claim 6, wherein said first external device comprises a sensor generating a current signal.

16. The interface in claim 6, wherein said second device comprising an external controller.

17. The interface in claim 6, wherein said second device consisting of a controller and an isolation circuit interposed between said interface and said external controller.

18. The interface in claim 6, wherein said second port including a third terminal for communicating at least one of data, control or commands, and clock.

19. The interface in claim 6, wherein said second port including a third terminal for communicating data, control or commands, and clock.

20. The interface in claim 6, wherein said second port including a third terminal for communicating at least one of data, control or commands, and clock.

21. The interface in claim 6, wherein said second port including a third terminal for communicating data, a fourth terminal for communicating control or commands, and a fifth terminal for communicating clock.

22. The interface in claim 6, wherein said operating circuit including a plurality of different operating mode circuits.

23. The interface in claim 6, wherein said operating circuit including means for configuring said operating circuit to operate in a particular mode of operation.

24. The interface in claim 23, wherein said mode of operation selected from the set of operating modes consisting of a digital input signal mode, a digital output signal mode, an analog input signal mode, an analog output signal mode, and combinations thereof.

25. The interface in claim 23, wherein said mode of operation selected from the set of operating modes consisting of a Mode 1 operating mode, a Mode 2 operating mode, a Mode 3 operating mode, a Mode 4 operating mode, a Mode 5 operating mode, a Mode 6 operating mode, a Mode 7 operating mode, and combinations thereof.

26. The interface in claim 6, wherein said operation selector selects an operating mode from among a plurality of defined modes of operation.

27. The interface in claim 6, wherein said operation selector comprising a microcontroller.

28. The interface in claim 6, wherein said operation selector comprising a microcontroller coupled with at least one analog-to-digital converter for converting analog signals to digital signals for processing by said microcontroller.

29. The interface in claim 27, wherein said operation selector microcontroller having a plurality of control lines for receiving input signals and a plurality of output signals to influence the operation performed by said operating circuit.

30. The interface in claim 6, wherein said plurality of operations including a digital input signal mode, a digital output signal mode, an analog input signal mode, an analog output signal mode, and combinations thereof.

31. The interface in claim 6, wherein said plurality of operations including a mode of operation selected from the set of operating modes consisting of a Mode 1 operating mode, a Mode 2 operating mode, a Mode 3 operating mode, a Mode 4 operating mode, a Mode 5 operating mode, a Mode 6 operating mode, a Mode 7 operating mode, and combinations thereof.

32. The interface in claim 6, wherein said operation selector being operative to activate portions of said operating circuit and to deactivate other portions of said operating circuit to define an active circuit that performs a selected operation.

33. The interface in claim 6, wherein said operating circuit comprising a plurality of modular circuits each for performing a predetermined signal processing function with respect to input signals and output signals, and said operation selector being operative to activate ones of said modules and to deactivate other ones of said modules to define one or more active modules that performs a selected operation.

34. The interface in claim 6, wherein said operation selector being operative to activate said modules to process a signal of a particular signal type.

35. The interface in claim 34, wherein said particular signal type comprises either an input signal type or an output signal type or both.

36. The interface in claim 6, wherein said interface communicating an output command to one of said first or second device commanding said external device to operate in a status corresponding to said command; and monitoring the actual operating status of said external device; said actual operating status being the same or different from the commanded status.

37. The interface in claim 6, wherein said first or second device comprise an actuator.

38. The interface in claim 6, wherein said first or second device comprise a sensor.

39. The interface in claim 6, wherein one of said first and second device comprise an actuator and the other of said first and second device comprise a sensor.

40. The interface in claim 6, wherein said interface further comprising an input current detection circuit that detects the state of a sensor current directly rather than detecting the sensor voltage to thereby reduce the effects of induced electrical noise on conductors coupling said sensor to said interface.

41. The interface in claim 6, wherein said interface further comprising input current detection means for directly detecting a sensor current rather than detecting sensor voltage determine sensor state to thereby reduce the effects of induced electrical noise appearing on sensor voltage on conductors coupling said sensor to said interface.

42. The interface in claim 6, wherein:

said interface is a comprehensive universal configurable interface for interfacing a multiplicity of analog, digital, voltage, and current based signals over a multiple orders of magnitude signal range between a controller and a transducer;

said first port including first and second electrical terminals;

said first external device comprises either a sensor or an actuator of a machine or process;

said first external device comprises a sensor generating a voltage or a current signal;

said second device consisting of a controller and an isolation circuit interposed between said interface and said external controller;

said second port including a third terminal for communicating at least one of data, control or commands, and clock;

said operating circuit including a plurality of different operating mode circuits, and said operating circuit including means for configuring said operating circuit to operate in a particular mode of operation;

said mode of operation selected from the set of operating modes consisting of a digital input signal mode, a digital output signal mode, an analog input signal mode, an analog output signal mode, and combinations thereof;

said operation selector comprising a microcontroller coupled with at least one analog-to-digital converter for converting analog signals to digital signals for processing by said microcontroller;

said operation selector being operative to activate portions of said operating circuit and to deactivate other portions of said operating circuit to define an active circuit that performs a selected operation.

43. The interface in claim 6, wherein:

said operating circuit comprising a plurality of modular circuits each for performing a predetermined signal processing function with respect to input signals and output signals, and said operation selector being operative to activate ones of said modules and to deactivate other ones of said modules to define one or more active modules that performs a selected operation;

said operation selector being operative to activate said modules to process a signal of a particular signal type;

said interface further comprising input current detection means for directly detecting a sensor current rather than detecting sensor voltage determine sensor state to thereby reduce the effects of induced electrical noise appearing on sensor voltage on conductors coupling said sensor to said interface.

44. An electrical input and output (I/O) interface comprising:

a first port for coupling said interface to a first external device;

a second port for coupling said interface with a second device; and

an operating circuit communicating with a first signal set at said first port and communicating a second signal set at said second port and performing an operation on one of said first signal set and said second signal set as an input and generating the other one of said first signal set and said second signal set as an output;

said operating circuit receiving an input from an external micro-controller directing a configuration of said operating circuit.

45. A method of interfacing a process or machine controller with a sensor monitoring a condition within said process or machine or an actuator acting to modify said process or machine with a controller receiving inputs from said sensor or sending commands to said actuator; said method comprising:

coupling said sensor or actuator with first and second electrical terminals of an interface having a plurality of operation mode circuits providing different signal type input and output functions including a digital input function, a digital output function, an analog input function, and an analog output function; and

controlling activation and deactivation of different ones of said operation mode circuits to provide a selected ones of said signal type input and output functions.

46. The method in claim 45, wherein said controlling activation and deactivation includes performing said activation and deactivation using a microcontroller.

47. The method in claim 46, wherein said microcontroller is adapted to receive control signals from an external controller.

48. The method in claim 46, wherein said controlling activation and deactivation including a microcontroller; said microcontroller is adapted to receive control signals from an external controller; and said interface couples with said sensor or said actuator exclusively through only said first and second electrical terminals.

49. An interface circuit comprising:

an output circuit that communicates an output command to an external device coupled with said interface commanding said external device to operate in a state corresponding to said command; and

a monitor circuit that monitors the actual operating state of said external device; said actual operating state being the same or different from the commanded state.

50. The interface circuit in claim 49, wherein said actual operating state is different from the commanded state.

51. The interface in claim 49, wherein said state corresponding to a status.

52. The interface in claim 1, wherein said interface further comprising a protection circuit for reducing damage to said interface that would otherwise result in damage to said interface as a result of misconnecting or miswiring said interface to one or said first or second external devices.

53. The interface in claim 6, wherein said interface further comprising a protection circuit for reducing damage to said interface that would otherwise result in damage to said interface as a result of misconnecting or miswiring said interface to one or said first or second external devices.

54. The interface in claim 1, wherein said interface further comprising a protection circuit for reducing damage to said first device or said second device that would otherwise result in damage to said interface as a result of misconnecting or miswiring said interface to one or said first or second external devices.

55. The interface in claim 6, wherein said interface further comprising a protection circuit for reducing damage to said first device or said second device that would otherwise result in damage to said interface as a result of misconnecting or miswiring said interface to one or said first or second external devices.

56. The interface in claim 54, wherein said interface further comprising an input current detection circuit that detects the state of a sensor current directly rather than detecting the sensor voltage to thereby reduce the effects of induced electrical noise on conductors coupling said sensor to said interface.

57. The interface in claim 54, wherein said interface further comprising input current detection means for directly detecting a sensor current rather than detecting sensor voltage determine sensor state to thereby reduce the effects of induced electrical noise appearing on sensor voltage on conductors coupling said sensor to said interface.

58. The interface in claim 55, wherein said interface further comprising an input current detection circuit that detects the state of a sensor current directly rather than detecting the sensor voltage to thereby reduce the effects of induced electrical noise on conductors coupling said sensor to said interface.

59. The interface in claim 55, wherein said interface further comprising input current detection means for directly detecting a sensor current rather than detecting sensor voltage determine sensor state to thereby reduce the effects of induced electrical noise appearing on sensor voltage on conductors coupling said sensor to said interface.

60. The interface in claim 6, wherein said interface further comprising means for measuring power, both real and imaginary, by dynamically switching between voltage measurements and current measurements.

61. The interface in claim 6, wherein said interface further comprising: a voltage measuring circuit and a current measurement circuit each coupleable to a load, a switching circuit for dynamically switching between said voltage measurement circuit and said current measurement circuit; said combination of voltage measurements and said current measurements permitting measurement of power consumed by said load.

62. The interface in claim 60, wherein said measurement of power including measuring real and imaginary power.

64. The interface in claim 1, further comprising means for controlling current delivered to or drawn by said first external device by providing a substantially constant current to said first external device.

65. The interface in claim 64, wherein said first external device comprises an actuator.

66. The interface in claim 6, wherein said interface further comprising a constant current control circuit for controlling a current drawn by a load device.

67. The interface in claim 66, said load device including a power level actuator in a process or machine.

68. The interface in claim 66, wherein said load device including an electromechanical solenoid actuated valve, and said constant current circuit being operative to reduce turn-on and turn-off mechanical shock to electromechanical solenoid actuated valves.

69. The interface in claim 66, wherein said load device including an inductive load component, said constant current circuit being operative to reduce electromagnetic interference (EMI) and RFA (radio frequency interference) caused by energizing or de-energizing said load device.

70. The interface in claim 66, wherein said load device including a relay device.

71. The interface in claim 66, wherein said load device including a solenoid valve device.

72. The interface in claim 66, wherein said constant current circuit eliminating the need for suppression circuits to suppress turn-on and turn-off mechanical shock to electromechanical devices and inductive loads.

73. The interface in claim 66, wherein said constant current circuit increasing the speed of operation of inductive load devices by driving them with a substantially constant current.

74. The interface in claim 73, wherein said load device includes an incandescent lamp, and said constant current circuit preventing inherent low-resistance initial current loads of said incandescent lamps from tripping circuit breakers.

75. The interface in claim 73, wherein said load device includes an incandescent lamp, and said constant current circuit substantially increasing lifetime before failure of said incandescent lamps by eliminating initial thermal shock resulting from high initial turn on currents.

76. The interface in claim 66, wherein said load device including an inductive load component, and said constant current circuit reducing destructive effects, both human and mechanical, of inductive L(di/dt) based transients that occur when de-energizing inductive loads.

76. The interface in claim 76, wherein said destructive effects including destructive mechanical effects to said inductive load containing device.

77. The interface in claim 76, wherein said destructive effects including destructive effects on humans in the vicinity of said inductive load containing device.

78. The interface in claim 66, wherein said load device including or coupled with a triac controlled by a triac control circuit, and said constant current circuit reducing half-cycle time delay in energizing and de-energizing alternating current (ac) loads that otherwise occur with triac control circuits.

79. The interface circuit in claim 6, wherein said interface is formed as a single integrated device within a common enclosure.

80. The interface circuit in claim 6, wherein said interface is formed on a single printed circuit substrate.

81. The interface in claim 6, wherein said selectable operation of said interface to inter-operate with a plurality of different sensors, actuators, and other transducers materially reducing design and engineering time associated with designing, assembling, and debugging operation of a system including said interface.